

SpiderFab: Process for On-Orbit Construction of Kilometer-Scale Apertures

Completed Technology Project (2012 - 2013)



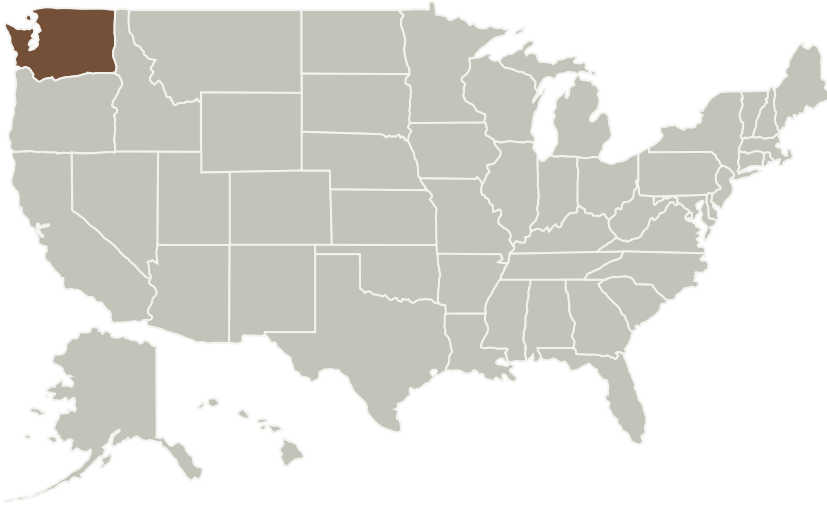
Project Introduction

SpiderFab is a novel additive manufacturing technique which combines the techniques of fused deposition modeling (FDM) with methods derived from automated composite layup to enable rapid construction of very large, very high-strength-per-mass, lattice-like structures. This project develops a process for automated on-orbit construction of very large structures and multifunctional components. The foundation of this process is a novel additive manufacturing technique called 'SpiderFab', which combines the techniques of fused deposition modeling (FDM) with methods derived from automated composite layup to enable rapid construction of very large, very high-strength-per-mass, lattice-like structures combining both compressive and tensile elements.

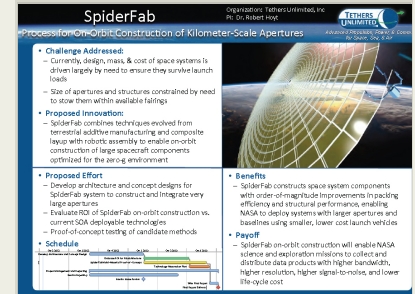
Anticipated Benefits

This on-orbit fabrication and integration process can be re-used to reduce the life-cycle cost and increase power, bandwidth, resolution, and sensitivity for a wide range of NASA Science and Exploration missions.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Tethers Unlimited Inc	Lead Organization	Industry	



Project Image SpiderFab:
Process for On-Orbit
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Apertures

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Primary U.S. Work Locations

Washington

Project Transitions

**September 2012:** Project Start**June 2013:** Closed out

Closeout Summary: The rapid development of high-performance nanosatellite platforms is enabling NASA and commercial ventures to consider performing missions to the asteroids, the Moon, and Mars at lower cost and on shorter timelines than traditional large spacecraft platforms. Currently, however, opportunities to launch secondary payloads to Earth escape are rare, and using chemical rockets to propel secondary payloads from LEO rideshares to escape is problematic due to the risks posed to primary payloads. The NanoTHOR effort has explored the technical feasibility and value proposition for using a simple momentum-exchange tether system to scavenge orbital energy from an upper stage in geostationary transfer orbit in order to boost nanosatellites to Earth escape. A NanoTHOR module will accomplish rapid transfer of a nanosatellite to an escape trajectory by deploying the nanosat at the end of a long, slender, high-strength tether and then using winching in the Earth's gravity gradient to convert orbital angular momentum into rotational angular momentum. In the Phase I effort, we developed a novel and simulated methods for controlling tether deployment and retraction to spin up a tether system, and these simulations demonstrated the feasibility of providing delta-Vs on the order of 800 m/s with a simple, low-mass tether system. Moreover, the NanoTHOR tether can act as a reusable in-space upper stage, boosting multiple nanosatellites on a single launch and doing so with a mass requirement lower than that of conventional rocket technologies. Serving as an escape-injection stage, NanoTHOR can enable a 6U CubeSat to deliver small payloads to Mars orbit, lunar orbit, and rendezvous with at least 110 of the known near-Earth asteroids. Evaluation of the technology readiness of the component technologies required for NanoTHOR indicate that the hardware required is all mid-TRL, and the lower-TRL controls and integration components can be advanced to mid-TRL with modest investment. By scavenging orbital energy from upper stages without a stored energy or propellant requirements, NanoTHOR permits deep-space nanosat missions to launch on rideshare opportunities, enabling NASA and commercial ventures to conduct affordable and frequent missions to explore deep space destinations.

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Tethers Unlimited Inc

Responsible Program:

NASA Innovative Advanced Concepts

Project Management

Program Director:

Jason E Derleth

Program Manager:

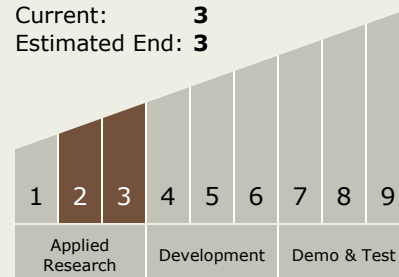
Eric A Eberly

Principal Investigator:

Robert Hoyt

Technology Maturity (TRL)

Start: 2
Current: 3
Estimated End: 3

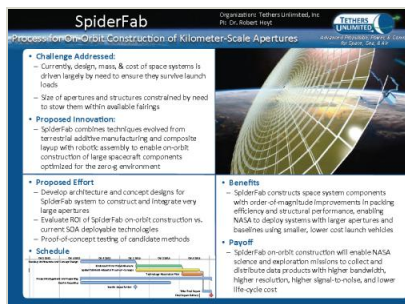


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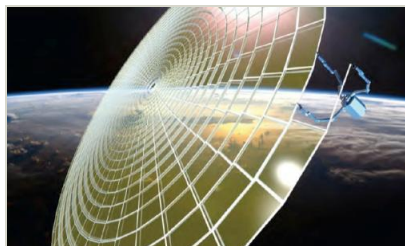


Images



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Project Image SpiderFab: Process for On-Orbit Construction of Kilometer-Scale Apertures (<https://techport.nasa.gov/image/102292>)



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Project Image SpiderFab: Process for On-Orbit Construction of Kilometer-Scale Apertures (<https://techport.nasa.gov/image/102127>)

Technology Areas

Primary:

- TX07 Exploration Destination Systems
 - TX07.2 Mission Infrastructure, Sustainability, and Supportability
 - TX07.2.4 Micro-Gravity Construction and Assembly

Target Destination

Earth